Identification of Gaps in Knowledge and Practices Affecting the Quality of Skins/Hides on the Eve of Eid-Ul-Adha in Pakistan

by

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Abstract

The 2nd largest export-oriented leather industry of Pakistan fulfills its 40% annual raw material demand during the eve of Eid-ul-Adha on which 6.0-8.0 million best-quality animals are being slaughtered within three days. However, a major portion of raw skins and hides (RSH) gets putrefied due to delayed preservation. The aim of this study was to explore the knowledge, attitude, and practices about RSH quality and its preservation in the general public from Punjab, Pakistan. A cross-sectional survey was conducted from February to May 2022 in which 948 individuals from 12 districts participated. Out of six, the overall mean knowledge score of the respondents about RSH preservation was 3.69±1.6 (61.5%). More than half (52.3%) of the respondents answered that salt could be an appropriate option to preserve RSH. However, contrary to their knowledge, only 4.2% (40/948) of respondents applied it correctly. About 56.6% of respondents donated RSH to religious institutes. The mean knowledge and practice scores of the respondents from rural areas were significantly higher ($p<0.001$) than those from urban areas (knowledge: 4.03 vs. 3.13; practice: 4.9 vs. 3.9). The knowledge and practice of preserving RSH using common salt application significantly increased ($p<0.001$) with the level of education (ORs: never attended school = 0.08; school-level education = 0.22 & College/University education = 1.0). In conclusion, almost half of the respondents had knowledge about RSH preservation; however, only a few (4%) practiced it correctly. These findings will be helpful to design effective and targeted interventions to improve the knowledge and practices of the public for better RSH preservation.

Introduction

The leather industry is the 2nd largest export-oriented industry of Pakistan, providing livelihood to more than half a million people and contributing 5.4% to the export earnings of the country[1] with an overall export value of US$ 0.833 billion in 2021.[2] Raw material for the leather industry is well supplied through one of the largest livestock populations in the world comprising nearly 213 million heads. Pakistan is the sixth-largest producer of skins and hides in the world and it is one of the biggest competitive advantages of Pakistan's leather industry.[3]

The raw skins and hides (RSH) supply chain consists of two components. One is the routine slaughtering in which animals are being slaughtered in slaughterhouses/slaughtering slabs; RSH is sold to the RSH collectors; they collect and preserve them and then sell them to big RSH collectors or directly to the tanneries.[4] The second and most important is the eve of Eid-ul-Adha when the bulk of RSH is produced in two to three days. Eid-ul-Adha/Qurbani/Greater Eid is the biggest pious event celebrated by the Muslim community all around the globe on the 10th day of the 12th month (Dhu-al-Hijjah) of the Islamic Lunar Calendar. The skin or hide of the sacrificial animal is directly donated to the welfare/religious organizations[5] or sold to the skin/hide (SH) collector and that money must be donated.[6] About 6.0-8.0 million best quality animals including sheep, goats, cattle, buffalo, and camels are slaughtered annually on this festival and the leather industry fulfills 30-40% of its annual raw material demand from this event.[5,7]

Since the Eid-ul-Adha started to be celebrated during the summer season within the last few years, RSH losses have been increasing year by year, e.g. on Eid-ul-Adha 2020, about 70% of skins/hides (4.2 to 5.4 million) were wasted.[8] This loss is also evident from the leather and leather goods export which dropped from $1.27 to $0.833 billion from 2014 to 2021, respectively.[2] There are multiple factors behind higher RSH loss starting from animal transportation to the slaughtering procedures and storage of skins and hides. Similarly, due to the increasing burden, most of the slaughtering is performed by non-professional butchers leading to more cuts and damage to the RSH.[7] Another malpractice is packing the flayed hides in a plastic bag which is extremely harmful to their quality. For common men, the value of RSH is negligible (less than 1% of an animal value which too must be donated according to religious obligation) and, therefore, there is a lack of interest to preserve the quality. However, from the tanner's point of view, if sacrificial animal hides are not

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preserved within an hour, the hot and humid weather can spoil them to such an extent that no valuable leather article can be produced from them.[9,10]

RSH is composed of 60-70% water and 25-30% protein which is prone to putrefaction within a few hours after its removal from a carcass.[11] This autolytic degradation is believed to be caused by the combined action of tissue enzymes and bacteria however the latter requires moisture for its activity.[12] Bacteria are naturally occupant on the RSH surface as well as in soil/environment and their main roles are to putrefy the RSH collagen protein.[13] The season in which qurbani is being performed in recent years in Pakistan is quite humid (monsoon/rainy) and hot. Therefore, both of these factors add up and cause the start of putrefaction much earlier than the expected time.

The best way to protect skins and hides from bacterial putrefaction is to process them immediately after the slaughtering of animalst.[14] However, this practice is not feasible even in routine slaughtering due to multiple reasons, i.e., busy schedule of tanneries; time required for transportation from the place of slaughtering to a tannery, etc.[15] This option is particularly not feasible on the eve of Eid-ul-Adha where millions of animals are being slaughtered in just three days. The other way which only seems feasible is to preserve or cure RSH with some curing agent. Curing/preservation is a process of creating an environment in which bacteria can't survive.[11] In the literature, several curing agents have been reported e.g., boric acid,[16] potassium chloride,[17] herbal-based products[18] and silica gel.[19,20] However, common salt (sodium chloride, NaCl) is the most practiced and least expensive material used worldwide to cure/preserve RSH, commonly known as wet-salting.[11] In this method, 40-50% NaCl of the green weight of skin/hide is applied immediately after flaying on the flesh side of RSH.[21] It brings about preservation through dehydration and bacteriostatic properties.[22]

Pakistani leather and leather products sector have tremendous potential and growth scope.[23] The skins of Pakistani animals are considered one of the best skins in the world.[24] However, to become more attractive globally, the raw material supply chain especially on the eve of Eid-ul-Adha should be studied more comprehensively. The big fraction of skins and hides which get wasted every year worth of billions of Pakistani rupees (PKR) can be saved through proper management and vision. Therefore, this study was conducted to assess the knowledge, attitudes, and practices of the common man regarding RSH preservation through common salt application and to identify the important loopholes in the preservation process. To the best of our knowledge, this is the first study in Pakistan, and we are very optimistic that the findings of this study will help to formulate more targeted interventions to better preserve RSH on the eve of Eid-ul-Adha leading to better economic growth.

Methodology

Study area and data collection

The study focused on the Punjab province which holds more than 50% of the total human and animal population of the country. Out of 36 districts of the Punjab, 12 districts were selected randomly. To assess the knowledge, attitude, and practices (KAP) of the general public about RSH preservation, a questionnaire was developed in consultation with the relevant experts, reviewing published literature and after multiple discussions with the stakeholders/collectors. The data was collected from 948 respondents who were involved in slaughtering at the eve of Eid-ul-Adha between February and May 2022. The survey comprised of three sections: 1) Demographic information of the participants (6 questions), 2) Knowledge about RSH preservation (6 questions), 3) Attitude towards correct practices regarding RSH preservation and Practices of participants about RSH preservation on the eve of Edi-ul-Adha (12 questions). Including the demographic data, the final questionnaire comprised 24 questions of which four were open-ended and 20 close-ended questions. The English version of the questionnaire was translated into Urdu (local language). Formal testing of the questionnaire was performed with 40 respondents in urban and rural areas prior to launching the final survey. An information sheet containing the details of the study was presented to the participants before obtaining consent from them and the data was kept strictly confidential by removing the personal identifier. The average time per interview was about 25 minutes.

Data analysis

The data were analyzed using R software 4.0.4 and RStudio version 1.4.1106 as an interface (R Core Team, 2021; RStudio Team, 2021). KAP scores were calculated by combining scores of respondents in each category, i.e. correct answers in knowledge questions, attitude questions, and practice questions. Each correct answer was given 1 and the incorrect answer was given 0. For continuous variables, i.e. knowledge, attitude, and practice scores, means were presented, and data related to demographic variables were presented as proportions and frequencies. Linear regression models were built to find out the association of demographic factors with mean knowledge, attitude, and practice scores using *lm* function. We identified three important practices that could affect RSH preservation; 1) putting the hair side of the skin inwards and the meat side outwards after flaying, 2) putting RSH in a plastic bag, and 3) application of common salt. The effect of demographic factors on identified practices was assessed using univariable analysis followed by a multivariable logistic regression model using *glm* function separately for each identified practice. Univariable analysis was performed using Pearson Chi-squared test and only those variables which yielded $p<0.2$ were further considered for the multivariable logistic regression model. The non-significant

Table I

Description of questions included in KAP survey along with correct and incorrect answers

Question	Correct options	Incorrect options
Methods to keep the quality of sacrificial RSH good	Salt application	Putting under shade.
		Putting in direct sunlight.
		Putting in a plastic bag.
		Putting in a plastic bag + putting under shade.
		Putting in a plastic bag + putting in direct sunlight.
How the skin of the sacrificial animal should be kept after slaughtering& flaying?	Inner side outwards and hair side inwards	Hair side outwards and inner side inwards
How does leftover meat affect the quality of RSH	Reduces Quality	Improves quality
Putting RSH in a plastic bag is good or bad	Bad	Good
How many hours after flaying salt should be applied in summer season	Immediately	Within 8 hours
		Within 24 hours
Who did slaughtering & flaying	Professional butcher	Untrained butcher
	Slaughterhouse	Own self
After flaying, where RSH was kept	Under shade	Under direct sun light
		In a water tub full of chilled water
How many hours after flaying, RSH was handed over to collector	0.5-01 hr	02-03 hrs
		04-05 hrs
		06-07 hrs
		More than 08 hrs
Which method was adopted to keep RSH quality good before handing it over to collector	Application of common salt.	Sprinkling of chilled water.
	Application of common slat & boric acid	Skin was handed over as it is
After how many hours of flaying, common salt was applied	0.5-01 hr	02-03 hrs
		04-05 hrs
		06-07 hrs
		More than 08 hrs
		Not applicable/Didn't apply salt
Quantity of salt used to preserve sheep & goat skin	01-02 kg	03-04 kg
	Not Applicable	
Quantity of salt used to preserve cow & buffalo hides	03-05 kg	06-08 kg
	Not Applicable	

variables and/or confounders (assessed at 20% change in the estimates of the remaining variables) were stepwise removed using a backward selection approach. The *sjPlot* package was used to take the final output of the model containing odds ratio, p-value and R^2. Odds ratios along with 95% confidence intervals (CI) are presented only for the significant variables in the multivariable model. The R^2 values were used to assess the model fit.

Ethical Approval

The study was approved by the Ethical Review Committee of the University of Veterinary and Animal Sciences, Lahore (No. DR/687).

Results

Demographic characteristics of the respondents

Out of 948 respondents, 40.1% performed slaughtering in urban areas, while 59.9%in rural settings. The majority of the respondents either got school level (47.5%) or college/university level (46.6%) education, while a small proportion (5.9%) had not received any formal education. Similarly, general data about the source of getting information concerning the importance of RSH and its preservation process; the type of an animal slaughtered on the eve of Eid-ul-Adha; to whom RSH was donated/sold, and the willingness of participants to slaughter their animals if the government makes some arrangement for a combined slaughtering of animals in their area on nominal rates, has been presented in Table II.

Respondents' Knowledge

The majority of the respondents (66.9%) were well aware that any cut (flaying cut) during the skin removal (flaying) could influence its quality; however, 33.1% believed that flaying cuts had no influence on the quality of skin (Table II). Similarly, 79.6% were well cognisant that the leftover meat reduces the quality of RSH. The correct preservation method of RSH was correctly identified by 52.3% of respondents. Responding to the question of when salt should be applied after flaying, particularly in the summer season, less than half of the respondents (46.1%) were able to answer it correctly. Similarly, when they were asked whether it is good or bad to keep/put the skins in a plastic bag after slaughtering, 63.2% and 36.8% picked the "bad" and "good" options, respectively. One very important parameter that how the skin of the sacrificial animal should be kept after slaughtering; only 39.1% of the respondents were able to answer correctly.

Respondents' Attitudes and Practices

Only 58.9% of the respondents performed the antemortem examination. Almost half (49.8%) of the respondents strictly instructed butchers to do flaying with care. The majority of the respondents (55%) slaughtered their animals themselves or obtained services from untrained butchers, while 45% respondents hired professional butchers for slaughtering. After flaying, the majority (63.1%) of the respondents kept skins incorrectly (hair side outwards and meat side inwards) while 36.9% of them, correctly. Similarly, majority of the respondents (66.8%) kept the skins under shade and the rest of the respondents kept RSH either in direct sunlight (31.1%) or in a water tub full of chilled water (2.1%). About 40.1% of the respondents reported that they placed the skins in plastic bags. About 43% of the respondents applied common salt or common salt + boric acid to preserve RSH before handing it over to the collector and the rest of the respondents either handed it over as it is (52.8%) or sprinkled chilled water (4.1%) to keep its quality good. Of those who applied salt or salt + boric acid (n=408) for RSH preservation before handing it over to the receiver (collector, religious/welfare organizations, etc.), the majority either delayed the salt application (54.7%), applied salt on the wrong side of RSH (77.5%), did not remove leftover meat before salt application (86%), applied inappropriate quantity of salt (86.8%) or placed RSH in a plastic bag or in direct sunlight after salt application (90.2%). Thus, only a small proportion of the respondents 4.2% (40/948) applied salt appropriately (Table II).

Association of demographic factors with knowledge and preservation practices

Out of six, the overall mean knowledge score of the respondents was 3.69±1.6. The mean knowledge score of the respondents from the rural area was significantly higher than those from the urban area (4.03 vs. 3.13, $p<0.001$). The mean knowledge score of respondents who never went to school (3.29±1.39) or received school-level education (3.5±1.61) was found significantly lower ($p<0.001$) than those who attended college/university (3.94±1.58).

Out of total practice score (12), the overall mean score of the respondents was 4.53. The mean practice score of the respondents from the rural area was significantly ($p<0.001$) higher than those from the urban areas (4.9 vs. 3.9). Similarly, the mean practice score of respondents who never attended school or received primary education was found significantly ($p<0.001$) lower (3.03 & 3.94, respectively) than those with college/university education status (5.32).

Table II

Demographic characteristics of respondents, general questions, and responses to questions related to knowledge, attitude, and practices about raw skins/hides preservation

Variable	Level	Responses	%
Demographic			
Area	Rural	568	59.9
	Urban	380	40.1
Education level	Never went to school	56	5.9
	School	450	47.5
	University/college	442	46.6
General Questions			
Source of getting information about the importance of RSH and its preservation process	Social media	301	31.8
	Religious/welfare organizations campaigns	154	16.3
	Announcement from nearby mosque	95	10.0
	Electronic media	60	6.3
	Newspaper	24	2.5
	Did not receive any information from any source	314	33.1
Type of animal slaughtered on Eid-ul-Adha	Cow	347	36.6
	Buffalo	128	13.5
	Camel	11	1.2
	Goat	357	37.6
	Sheep	105	11.1
To whom RSH was donated	Religious institutes	537	56.6
	Welfare organizations	141	14.9
	Poor men	93	9.8
	Butchers	51	5.3
	Sold to RSH collectors	63	6.7
	Buried into the earth	15	1.6
	Don't know	48	5.1
If the government makes some arrangements for a combined slaughtering of animals in your area at nominal rates, would you prefer to use this facility?	Yes	301	31.7
	No	268	28.3
	Depends upon the distance from home	379	40
Knowledge			
Flaying cuts affect the price of the RSH	Yes	634	66.9
	No	314	33.1
Methods to keep the quality of sacrificial RSH good	Salt application	496	52.3
	Putting under shade	203	21.4
	Putting in direct sunlight	66	7.0
	Putting in a plastic bag	71	7.5
	Putting in a plastic bag + putting under shade	34	3.6
	Putting in a plastic bag + putting in direct sunlight	78	8.2
Putting RSH in a plastic bag is good or bad	Good	349	36.8
	Bad	599	63.2
How the skin of the sacrificial animal should be kept after slaughtering& flaying?	Inner side outwards and hair side inwards	371	39.1
	Hair side outwards and inner side inwards	577	60.9
How does leftover meat affect the quality of RSH?	Improves quality	193	20.4
	Reduces Quality	755	79.6
How many hours after flaying salt should be applied in summer season?	Immediately	437	46.1
	Within 8.0 hours	277	29.2
	Within 24.0 hours	234	24.7

Variable	Level	Responses	%
Attitude & Practices			
Did you observe the physical appearance of the skin before slaughtering?	Yes	558	58.9
	No	390	41.1
Who did slaughtering & flaying?	Professional butcher	414	43.7
	Untrained butcher	112	11.8
	Slaughterhouse	12	1.3
	Own self	410	43.2
Had butcher/own self been instructed/reminded to avoid flay cuts?	Yes	472	49.8
	No	476	50.2
After flaying, how RSH was kept	Meat side outwards and hair side inwards	350	36.9
	Hair side outwards and meat side inwards	598	63.1
After flaying, where RSH was kept	Under direct sun light	295	31.1
	Under shade	633	66.8
	In a water tub full of chilled water	20	2.1
Did you put the RSH in a plastic bag after flaying?	Yes	380	40.1
	No	568	59.9
How many hours after flaying, RSH was handed over to the collector?	0.5-1.0 hr	136	14.3
	2.0-3.0 hrs	304	32.1
	4.0-5.0 hrs	202	21.3
	6.0-7.0 hrs	177	18.7
	More than 8.0 hrs	129	13.6
Which method was adopted to keep RSH quality good before handing it over to the collector?	Application of common salt	389	41.0
	Application of common slat & boric acid	19	2.0
	Sprinkling of chilled water	39	4.1
	RSH was handed over as it is	501	52.9
After how many hours of flaying, common salt was applied	0.5-01 hr	185	19.5
	02-03 hrs	117	12.3
	04-05 hrs	39	4.1
	06-07 hrs	44	4.6
	More than 08 hrs	23	2.4
	Not applicable/Didn't apply salt	540	57.1
Quantity of salt used to preserve sheep & goat skin	01-02 kg	158/462	34.2
	03-04 kg	42/462	9.1
	Not applicable	262/462	56.7
Quantity of salt used to preserve cow & buffalo hides	03-05 kg	151/486	31.1
	06-08 kg	57/486	11.7
	Not applicable	278/486	57.2
Did the leftover meat remove before salt application	Yes	196/408	48.0
	No	212/408	52.0
Number of respondents who applied salt within an appropriate time limit, location, technique, quantity, and method			
No. of respondents practiced RSH preservation through the salt application (common salt or common salt+boric acid).		408	43.0
No. of respondents applied salt within an appropriate time limit (0.5-01 hr).		185	19.5
No. of respondents applied salt in the appropriate location (on the meat side of the RSH).		92	9.70
No. of respondents applied salt through an appropriate technique (removed leftover meat before salt application).		57	6.0
No. of respondents applied the appropriate quantity of salt (1-2 kg for goat/sheep; 3-5 kg for cow/buffalo).		54	5.7
No. of respondents who kept RSH in an appropriate way (did not place RSH in a plastic bag or in direct sunlight after salt application).		40	4.2

Table III

Linear regression model to find out the association of education and locality with knowledge and practice about RSH preservation

Variable	Predictor	Estimates	CI	P-value
KSUM	Intercept	3.39	3.20 – 3.57	<0.001
	Area (Rural)	0.91	0.71 – 1.11	<0.001
	Education level (Never went to school)	-0.71	-1.13 – -0.28	0.001
	Education level (School)	-0.47	-0.67 – -0.27	<0.001
PSUM	Intercept	4.67	4.39 – 4.96	<0.001
	Area (Rural)	1.06	0.75 – 1.37	<0.001
	Education level (Never went to school)	-2.34	-2.99 – -1.69	<0.001
	Education level (School)	-1.41	-1.72 – -1.10	<0.001

Association of demographic characteristics with identified practices

The practice of putting the hair side of the skin inwards and the meat side outwards after flaying was significantly less (p<0.001, OR = 0.73) in rural areas than those in urban areas (Table IV). Similarly, this practice was found five times less (p<0.001; OR = 0.21 & 0.65) among respondents who never went to school and two times less among those who received school-level education compared to those who attended college/university. The other important practice of putting RSH in a plastic bag was three times higher (p<0.001; OR = 2.76) among respondents from rural areas compared to urban areas. Another important practice of common salt application was found significantly more common (OR = 2.31, p<0.001) in the respondents from rural areas compared to the urban areas. Similarly, this practice was significantly (p<0.001) less in respondents who never went to school (OR = 0.08) or had school-level (primary) education (OR = 0.22) as compared to those who received college/university-level education.

Table IV

Summary of multivariable logistic regression model to find out the association of education and locality with identified practices

Variable	Predictor	Odds ratio	95% CI	P-value
Skin inwards	Urban	1.00	-	-
	Rural	0.73	0.56 – 0.96	0.026
	College/University-level education	1.00	-	-
	Never went to school	0.21	0.09 – 0.43	<0.001
	School-level education	0.65	0.49 – 0.85	0.002
Plastic bag utilization	Urban	1.00	0.67 – 1.02	0.080
	Rural	2.76	2.11 – 3.64	<0.001
Application of common salt	Urban	1.00	-	-
	Rural	2.31	1.72 – 3.12	<0.001
	College/University-level education	1.00	-	-
	Never went to school	0.08	0.03 – 0.17	<0.001
	School-level education	0.22	0.17 – 0.30	<0.001

Discussion

Knowledge related to RSH preservation

This is the first study to identify the knowledge, attitude and practices of the Pakistani population regarding RSH handling and preservation on the eve of Eid-ul-Adha. This result may reflect the situation that there is a lack of systemic interventions in respondent's knowledge of RSH preservation. Overall, the knowledge of the respondents from urban areas was found to be lower than that of rural areas. It could be due to the fact that in Pakistan; most of the people living in cities go to their native rural areas to celebrate this eve with their loved ones.[7,25] So, this urban population does not truly mean it. The least knowledge about RSH preservation and its quality safeguarding was found in the respondents with never went to school education status and highest among those with college/university education status. However no significant difference of knowledge was found between the never went to school and school education status. This could be due to the access to print, electronic and particularly social media to the participants with higher education status.

Attitude and practices related to RSH preservation

A comprehensive review of the slaughtering procedure on the eve of Eid-ul-Adha is mandatory for a better understanding of the mega wastage of RSH during this event. Basically, the slaughtering of animals at Eid-ul-Adha is performed in two ways, individual slaughtering and combined slaughtering (Figure 1). In both types of slaughtering, the animal is purchased either directly from a farmer, temporary livestock market (especially established by a local government for two to three weeks before Eid-ul-Adha around the cities to facilitate the public) or permanent livestock markets (exists throughout the year around the cities).[7,26,27]

In both types of slaughtering systems, one commonality is that flaying is almost always done by hand, therefore, RSH contains a greater number of flaying cuts. Even in combined slaughtering (10-20 animals are slaughtered at a single and open place) slaughtering is performed by professional and amateur butchers,[7] flaying cuts also prevail here too, because these butchers are always in a hurry to slaughter more animals per day to make more money. After flaying, most of the time people focus on getting meat as soon as possible because they have to cook it for a family lunch or distribute it among friends/needy people, so they intentionally ignore preserving it with salt.

Overall, 43% (408/948) of respondents preserved RSH through common salt or common salt+boric acid application. However, out of this, the percentage of respondents who applied salt correctly

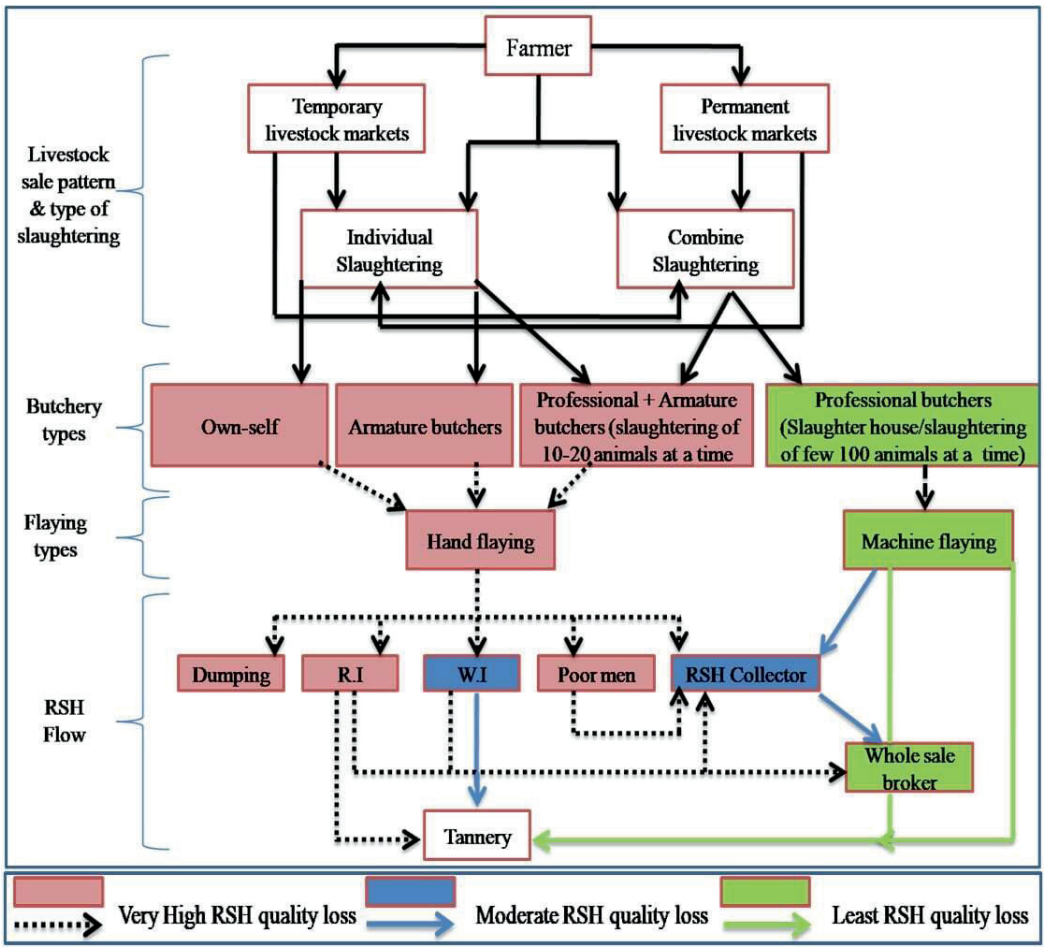

Figure 1. Livestock sale pattern; types of slaughtering; butchery types; flaying types and RSH flow on the eve of Eid-ul-Adha in Pakistan. Source: Own illustration based (RI= Religious institutes; WI= Welfare institutes)

was incredibly low. Only 4.2% (40/948) respondents had applied salt correctly i.e. within an appropriate time limit (0.5- 1.0 hr), on correct side of the RSH, after removing the leftover meat, sufficient salt quantity and placing RSH under a shade. There could be multiple reasons behind this fact but the major one is evident from the comments of the respondents. They reported that a few years ago, the price of small and large skins was quite high which has been much reduced now. Then why should they apply salt and waste their money? Why shouldn't they donate it as such or dump it into the earth? They also emphasized that the government should increase the price of RSH. Therefore, due to the lower price of RSH, common men are not well interested to apply salt because for them the RSH is nothing except a liability. A few years ago; the price of Eid-ul-Adha skins and hides was really good because at that time this festival was celebrated in the winter season and overall temperature in those months was not quite high and RSH did not putrefy so quickly. However, the temperature and humidity in the current as well in an upcoming couple of years would be quite high and the proportional risk of RSH putrefaction would be very high without salt application. Secondly, people are not well aware of the importance of timely salt application, and only 19.5% (185/948) applied salt within an appropriate time limit (0.5-1.0 hr). Similar findings have also been reported from Bangladesh on the eve of Eid-ul-Adha where the public is also not aware of applying salt timely rather it is considered as the duty of tanneries and RSH collectors.[28]

Thirdly, it is very important to know how to keep the skin after flaying. The meat side of RSH should always be kept outwards and the hair side inwards and salt is always applied on the meat side, however, only 9.7% (92/948) of respondents applied salt on the correct side. Fourthly, removing leftover meat and fat from RSH before salt application is also important for its proper preservation but only 6% (57/948) did this practice in the correct way. Five, the correct quantity of salt application is also very important to preserve RSH from putrefaction but only 5.70% (54/948) did it in the correct way. Similarly, after salt application, it's important to keep RSH under shade and in a well-ventilated place without putting it in a plastic bag. Keeping/putting RSH in a plastic bag increases the temperature which in turn facilitates bacterial growth and thus speeds up the putrefaction process. It is a very bad practice prevailing in the public and more than one-third (40.08%) of respondents put RSH in a plastic bag (either at the home level or used as a means of transportation from home to a collection/donation center). All the aforementioned factors contributed significantly to producing an overall score of 4.2%.

We also have identified some very important individual practices which are being practiced differently by rural and urban populations and education status. The practice of putting the hair side of the skin inwards and the meat side outwards after flaying in the respondents from rural areas was observed significantly lower than those from urban areas. Similarly, this practice was found significantly less in the respondents with never went to school and school education status as compared to those with college/university education status (Table IV). It means the urban population with higher education status is more adapted in this practice. The major reason could be the higher awareness (through social/electronic/print media) or due to higher income and affordability, most of the urban respondents could have hired professional butchers for slaughtering and flaying. The other important practice of putting RSH in plastic bags was found significantly less in the respondents from rural areas as compared to urban area respondents. If three respondents from the urban side were putting RSH in plastic bags, then only one respondent from the rural area was doing the same practice. Education status did not affect this practice significantly. The possible reason could be less availability of plastic bags in the rural areas as fertilizer empty bags are excessively available in the rural areas so they might have placed RSH in those bags instead of plastic bags while handing over RSH to the collector. The next very important practice, salt application, was found significantly more in the respondents from the rural areas as compared to the urban area. However, this practice was significantly found less in the respondents with never went to school and school education as compared to college/university education status. Both types of respondents, never went to school and school education status, had also a significant difference with each other in this practice. The possible reason could be the rural background of most of the respondents from urban areas who, although residing in urban areas, have performed slaughtering in their native rural areas. The education level had a significant effect on the said practice which implies that by improving the education/knowledge of the population their practice of salt application could be improved.

Based on the results of this study, we have made some calculations to know the economic impact of RSH wastage. According to the available literature, about 6.0-8.0 million animals are slaughtered on this eve. In this calculation, we have assumed an average price of a well-preserved and well-flayed RSH according to the available market rate. As is evident from Table V, every year Pakistan is bearing a loss worth of PKR 17,211.9 million. To save all these RSH, Pakistan needs to spend 952.9 million PKR/annum (Table VI) and as a result can save PKR 16,258.7 million per annum.

Conclusion

About half of the respondents knew about the skin/hide preservation method, however, the majority did not practice it correctly. The incorrect practices include delayed salt application (54.7%), applying salt on the wrong side (77.5%), did not remove leftover meat before salt

Table V

Per annum loss (million PKR) due to RSH wastage on the eve of Eid-ul-Adha

RSH type & percentage	Production	RSH lost (95%)	Avg. price/RSH	Total Loss (Million PKR)
Cow hides (36.6%)	2,562,700	2,434,565	3,000	7,303.7
Buffalo hides (13.5%)	942,200	895,090	4,000	3,580.4
Camel (1.2%)	84,000	79,800	1,500	119.7
Goat (37.6%)	2,630,600	2,499,070	400	999.6
Sheep (11.1%)	780,500	741,475	200	148.3
Annual import of RSH	0.00	0.00	0.00	5,060
			Total	17,211.7

Table VI

Per annum estimated expense (million PKR) to save RSH on the eve of Eid-ul-Adha

RSH type	No. of RSH	Salt req. to save one RSH (kg)	Avg. price of salt (PKR/kg)	salt cost (PKR)	Total cost of salt (million PKR)
Cow	2,434,565	5	15	75	182.6
Buffalo	895,090	5	15	75	67.1
Camel	79,800	5	15	75	6
Goat	2,499,070	2	15	30	75
Sheep	741,475	2	15	30	22.2
Awareness campaign cost	N/A	N/A	N/A	N/A	600
				Total	952.9

application (86%), applying inappropriate quantity of salt (86.8%), or placed skin/hide(s) in a plastic bag or under direct sunlight (90.2%). Thus, only a small proportion of the respondents, 4.22% (40 out of 948), preserved skins/hides using the correct method. Hence, the government, Pakistan Tanners' Association (PTA) and related non-government organizations need to pay more focus on mobilizing the RSH preservation campaign through salt application on social media by hiring some professionals. It could be a more effective way as the majority (31.75%) of the respondents got information through this channel. The other effective and cheaper way could be initiating awareness campaigns through religious/welfare organizations or Friday religious sermons close to Eid-ul-Adha in mosques. In addition, our findings can also be used to design more effective and targeted interventions to improve the knowledge and practices of the general public and as baseline data for monitoring future interventions.

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References

1. Bushra, S., Khalil, P. S and Ali, S. A.; Measuring undesirable output in efficiency evaluation: the case of tanneries in Pakistan. *PalArch's J Archaeol Egypt/Egyptology* **18**, 392–413, 2021.
2. Zafar, S., Tayyab, M and Salam, A.; Pakkistan tanners association annual report, pp 5-13, 2021. https://www.pakistantanners.org/documents/annualreport2021.pdf

3. Shah, T., Zafar, S., Muslim, E., et al.; Pakistan Export Strategy 2023-2027: Leather and Leather Goods. International Trade Center Geneva, Switzerland, pp: 1-101, 2022. https://tdap.gov.pk/wp-content/uploads/2022/08/Leather-and-Leather-Goods-Export-Strategy-4_web.pdf
4. Khaskheli, A. A.; Skin and Hides Selling Practices at Coastal Area of Sindh Province of Pakistan. *Biomed J Sci Tech Res* **30**, 23401–8, 2020.
5. Nawaz, M., Yousafzai, M. T., Khan, S. et al.; Assessing the formal and informal waste recycling business processes through a stakeholders lens in Pakistan. *Sustainability* **13**, 11717, 2021.
6. Saeed, A.; A fourth of Eid animal hides in Pakistan spoil due to poor processing-tanning association. https://arab.news/c5bn6
7. Mallhi, T. H., Khan, Y. H., Alotaibi, N. H. et al.; Celebrating Eid-ul-Adha in the era of the COVID-19 pandemic in Pakistan: potential threats and precautionary measures. *Clin Microbiol Infect* **26**, 1714–5, 2020.
8. UVAS.; Hide saltation Eid-ul-Adha by UVAS Dept. of leather & fiber technology, 2021. https://www.youtube.com/watch?v=He-w4-HSuqM
9. Fizza, I.; Processing of animal hides begins at tanneries. https://www.dawn.com/news/1210907
10. Jabri, P.; Lack of awareness damages hides worth Rs. 1.5 bn on Eid –ul-Azha: PTA. https://www.brecorder.com/news/367495.
11. Hernandez, E., Marmer, W., Kolomaznik, K., Cooke, P., & Dudley, R.; Mathematical model of raw hide curing with brine. *JALCA* 103, 167-173, 2008.
12. Rao, B. R., & Henrickson, R. L.; Preservation of hides with soda ash. *JALCA* 78, 48-53, 1983.
13. Vijayalakshmi, K., Judith, R and Rajakumar, S.; Novel plant based formulations for short term preservation of animal skins. *J Sci Ind Res* **68**, 699–707, 2009.
14. Bayramoğlu, E. E., Yilmaz, S and Çivi, S.; World raw hide and skin exports and some microbiological problems during exportation. In: International Conference on Advanced Materials and Systems (ICAMS) The National Research & Development Institute for Textiles and Leather-INCDTP, pp. 403–7, 2018.
15. Nur-A-Tomal, M. Sand Hashem, M. A.; A novel method to preserve goat skin with indigenous plant extract to reduce salinity in the effluent. In: In International Union of Leather Technologists and Chemists Congress 2017 CSIR-CLRI, pp. 46–55, 2017.
16. Kanagaraj, J., John, S. V., Muralidharan, C. et al.; Alternatives to sodium chloride in prevention of skin protein degradation—a case study. *J Clean Prod* **13**, 825–31, 2013
17. Bailey, D. G., & Gosselin, J. A.; The preservation of animal hides and skins with potassium chloride. *JALCA* 91, 317-333, 1996.
18. Preethi, V., Rathinasamy, V., Kannan, N., Babu, C., & Sehgal, P. K.; Azardirachta indica: a green material for curing of hides and skins in leather processing. *JALCA* 101, 266-273, 2006.
19. Kanagaraj, J., Chandra, B. K., Sadulla, S. et al.; Cleaner techniques for the preservation of raw goat skins. *J Clean Prod* **9**, 261–8, 2001
20. Munz, K.; Silicates for raw hide curing. *JALCA* 102, 16-21, 2007.
21. Vankar, P. S and Dwivedi, A. K.; Raw skin preservation through sodium salts—a comparative analysis. *Desaltation* **249**, 158–62, 2009.
22. Babu, T, G., Nithyanand, P., Babu, N. K. et al.; Evaluation of cetyltrimethylammonium bromide as a potential short-term preservative agent for stripped goat skin. *World J Microbiol Biotechnol* **25**, 901–7, 2009.
23. Shahab, S and Mahmood, M. T.; Comparative advantage of leather industry in Pakistan with selected Asian economies. *Int J Econ Financ Issues* **3**, 133–9, 2013.
24. Ghafoor, A., Aslam, M and Rasool, S.; Determinants of Leather Goods Exports : A Case of Pakistan. *J Bus Econ* **4**, . 2012;4(2):256–69.
25. Rahman, F. N., Rahman, A. F., Iwuagwu, A. O. et al.; COVID-19 Transmission due to mass mobility before and after the largest festival in Bangladesh: An Epidemiologic Study. *J Heal Care Organ Provision Financ* **58**, 00469580211023464, 2021.
26. Atif, M., Saqib, A., Ikram, R. et al.; The reasons why Pakistan might be at high risk of Crimean Congo haemorrhagic fever epidemic; a scoping review of the literature. *Virol journal* **14**, 1–7, 2017.
27. Mallhi, T. H., Khan, Y. H., Tanveer, N. et al.; Commentary: surveillance of Crimean-Congo haemorrhagic fever in Pakistan. *Front public Heal* **5**, 132, 2017.
28. Strasser, J., Dannenberg, P and Kulke, E.; Temporary resource availability and quality constraints in the global leather value chain - The impact of the festival of sacrifice on the leather industry in Bangladesh. *Appl Geogr* **45**, 410–419, 2013.